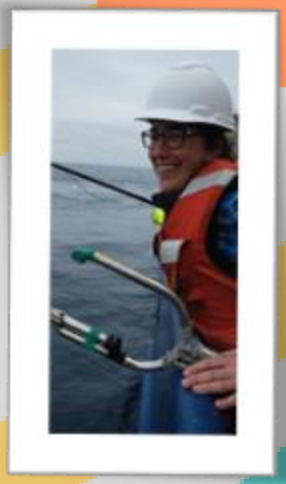
EPISODE TWO | RESOURCE PACK

ACTUALLY, IT'S PHYTO-PLANKTON!

Meet Dr Deborah Steinberg

Debbie is the Professor and Chair, Biological Sciences Department, Virginia Institute of Marine Science, William & Mary.
Deborah is a biological oceanographer and zooplankton ecologist. Her research addresses long-term effects of climate change on zooplankton communities, and the role that zooplankton play in ocean carbon and nutrient cycling. She is currently conducting research in Antarctica, the North Atlantic, the Sargasso Sea off Bermuda, and Chesapeake Bay. She also teaches courses on oceanography and science communication. She loves going to sea, and even after more than 30 years in oceanography still gets excited about looking at plankton under the microscope.

Meet Dr Colleen Durkin



Colleen is a biological oceanographer at the Moss Landing Marine Laboratories (California, USA). She earned her PhD in Oceanography (University of Washington) studying how phytoplankton growing in the surface ocean respond to changing environmental conditions. Now she studies how the carbon generated by phytoplankton is sequestered in the deep ocean by sinking particles. She goes to sea and uses detailed imaging and DNA sequencing to resolve the biological details needed to accurately monitor and predict this complex aspect of the global carbon cycle.

Food Glorious Food!

The National Science Week 2021 Schools Theme is "Food: Different by Design". On the podcast we've been playing our phytoplankton version of "Six Degrees of Separation from Kevin Bacon" game. (mmmm….bacon!). Now it's your turn!

Talk amongst yourselves...

What's your favourite food? And how can you connect it back to phytoplankton?

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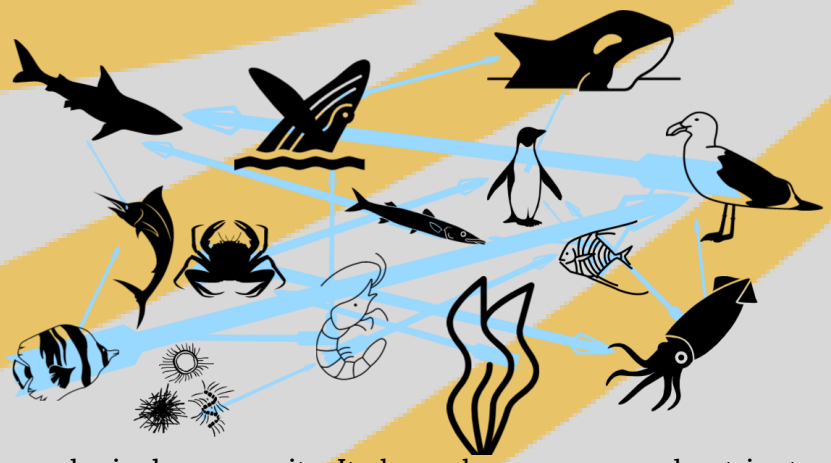
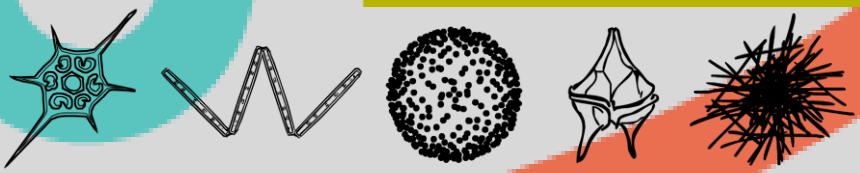
Food Web. What the Heck?



A food web is a representation of what eats what in an ecological community. It shows how energy and nutrients are transferred from plants to herbivores and carnivores. All of these organisms and creatures exist on "trophic levels". Plants are considered lower trophic levels and things that eat plants are higher up. Creatures that eat other animals are on the higher tropic levels. **Trophic** is a word commonly used in biological science and basically means food, or something related or pertaining to nutrition. All creatures and trophic levels are interconnected like a web.

Food Web or Food Chain?

A food web is a bunch of interlocking food chains. A food chain is more simple, linear (like a straight line), and in only one direction. It usually starts with a producer (such as a plant) and then it goes up from there. When you put a bunch of those together in all different directions, then you have a food web!



Primary Producers

Phytoplankton are primary producers in the ocean which means they are the first producers of organic carbon. A lot of the carbon on Earth is in gas (carbon dioxide in the atmosphere), and that's not something that you can eat. That carbon needs to be turned into organic matter before it becomes food. Phytoplankton use the sun's energy in order to take that carbon dioxide out of the atmosphere and produce organic carbon in their cells. They transform that gaseous carbon into something that can now be eaten. Phytoplankton are the main primary producers in the ocean.

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Krillin' it!

Krill are a type of **zooplankton**. They are the next trophic level above phytoplankton. Zooplankton get their energy from eating phytoplankton, then zooplankton become food for bigger creatures, and famously feature as a favourite of whales.

Krill are one of Debbie's specialities. They are a really important part of the food web. She catches them using net tows and brings them onboard the research ship. She explains how you can hold up a krill and see right into their guts. You can see the greenish, golden brown colour of the phytoplankton in their stomachs. Debbie says it's like if you're stomach was slightly transparent, and your friend could tell you had a salad for lunch.

Debbie also dissects zooplankton and looks at their guts under a microscopic. She extracts the pigments of the phytoplankton and can tell what the zooplankton have been eating by examining those pigments.

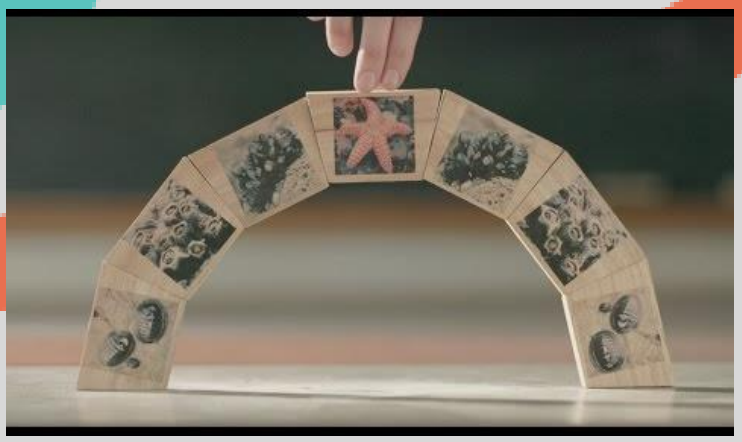
Keystone Species

Keystone species are a species on which other species in an ecosystem largely depend upon. If the keystone species were to be removed, that would be bad news for an ecosystem. Other organisms in the ecosystem may not even survive without it. It may be that the keystone species are food for other organisms, or it may be that the keystone species are integral to controlling the numbers of other organisms.

Trophic Cascade

A trophic cascade is when you add or remove a top predator from an ecosystem and that effects the abundance or survival of the next trophic level down. That also changes the ecosystem significantly. There is a cascading effect down the food chain.

This happened in 2014-15 on the US west coast. There was a big die-off of sea stars in the inner-tidal zone due to a sea star wasting syndrome. This released grazing pressure on one of their favourite foods: sea urchins. The sea urchins were able to grow completely uncontrolled and then they grazed on kelp forests. This caused a massive reduction and die-off of kelp forests.



Video 1: Click image above to play

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Get 2 Work!

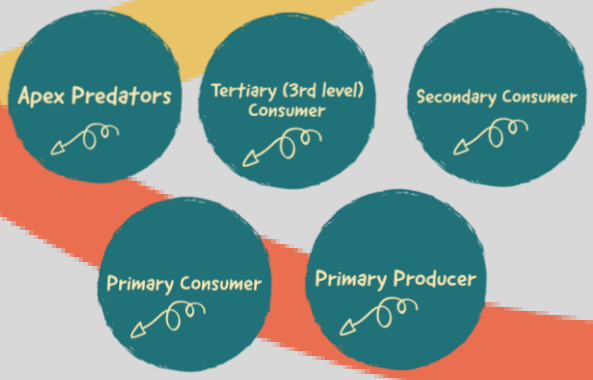
Explore marine food webs with this hands-on activity.

Materials

- A corkboard
- Push pins
- Wool, string or elastic bands
- Print and cut out the species cards

Method

1. Spread the cards out across the cork board randomly and pin them down with the push pin
2. Connect predators to prey using the wool, string or elastic bands
3. You may need to do some research to ensure you have connected all the predators to their prey
4. Quickly you will notice that the board becomes a web
5. Label the creatures with trophic levels



For board game lovers

The Oligotrophic Game is a card game. It is A LOT more complex and suitable for students in years 11 and 12. The game, as well as related lesson plans, worksheets and other resources are available at the link below:

https://www.nsta.org/science-teacher/science-teacher-mayjune-2021/oligotrophic

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Eat or be Eaten

In the simplest terms, the food web consists of **primary producers**, **predators**, **prey**, and **apex predators**. There are also **decomposers** like bacteria and detritivores. We already talked about primary producers (see above). A predator is an animal that preys on (aka eats) another organism. Prey are organisms that are eaten by predators. Most creatures are both. An apex predator is at the top of the food chain, which no natural predators of their own. Apex predators in the ocean include sharks and orca whales. Many people consider humans to be apex predators too.

Video 2: Click image above to play

Colleen thinks the most direct thing we can do as humans to reduce our pressure on the marine food web and lower the chance of tropic cascade is to think carefully about the type of fish we eat. Some fish are important players in food webs and fishing practices that can strongly affect the food web because it effects the prey that fish eat or the predators that depend on fish for food. Colleen loves seafood, but she encourages us to think about where our seafood comes from, which species, and whether it's coming from a sustainable fishery.

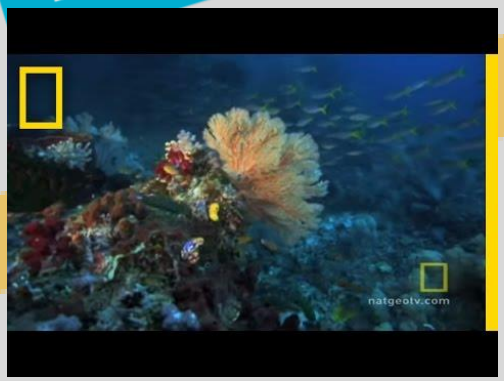
Warming ocean temperatures play a significant role in changing ocean ecosystems. The reason the ocean is getting warmer is because of human-caused climate change. Colleen explains that if we start taking climate change seriously and try mitigating our impact on the climate, then that would be a responsible way to try to avoid more trophic cascades.

In Queensland, we have **green zones** on the Great Barrier Reef. Green zones are areas where you are not allowed to take fish. They are places for fish to restock and take a break from being made into our dinner. The point is to stop these trophic cascades from occurring. Lachlan thinks it's a neat intersection between commercial industry, environmental managers, and the scientists

Video 3: Click image above to play

Imagine an Ecosystem

Coral reefs (like the GBR) have several different primary producers (the main one being phytoplankton). There are also seagrasses as well as brown and red algae growing on the reef. What's really neat about coral reefs is that there are also primary producers in the corals. They're called zooxanthellae and they're symbionts. Plus, they are a type of dinoflagellate (phytoplankton) that live in the coral tissue, providing nutrients to the corals. The corals eat zooplankton, catching them with their tentacles so they may be considered primary consumers in the coral reefs. There are other consumers: fish, sea stars, worms and so on. And then there are predators like sharks and barracuda. As with any ecosystem, there are also the decomposers such as detritivores (things that eat dead stuff), and bacteria that break down a lot of the organic matter. Coral reefs are some of the most diverse ecosystems and food webs on the planet.



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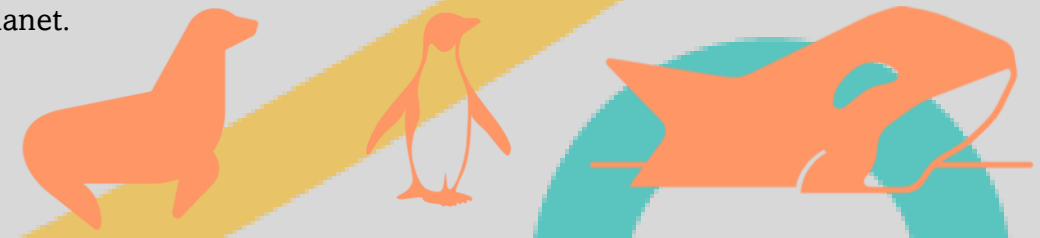
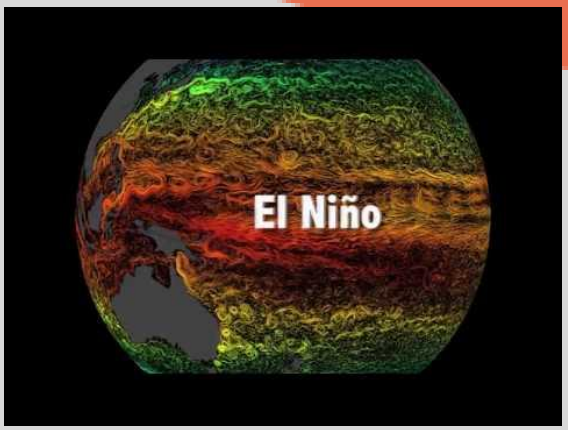


In Antarctica, it's very different. There are some similarities, for example phytoplankton are the primary producers and on the ocean bottom there are some algae that grow too. Around Antarctica there are massive swarms of krill. The swarms are so huge they can go on for a hundred kilometres (that is the same distance as the drive from Sunshine Coast to Brisbane). Krill swarms are fed upon by several different animals including baleen whales, penguins, sea birds and seals. They are very important to the ecosystem in Antarctica. In it's nutrient rich waters, there are big zooplankton and large things that eat them because the krill provide so much nutrition.

Zones in the Ocean

Earth oceans have productive zones and non-productive zones. It's similar to rainforests and deserts on the land. Productive zones have all the right conditions for life to thrive, and non-productive don't. You can think of them as ocean rainforests and ocean deserts.

The productive and non-productive zones are particularly impacted by weather patterns. El Niño and La Niña whether patterns directly affect the areas of the ocean near the equator, especially the equatorial pacific. During a La Niña that means that the changes in the wind that go across the equator cause changes in the ocean currents. You get a much stronger upwelling, meaning deep nutrient rich water gets mixed up to the surface and fuels phytoplankton blooms. That happens normally, but during a La Niña it's waaaaaaaay more productive and extends further out into the ocean and further up the coastline. In El Niño, it's the opposite and the zones become less productive that usual.



Video 5: Click image above to play

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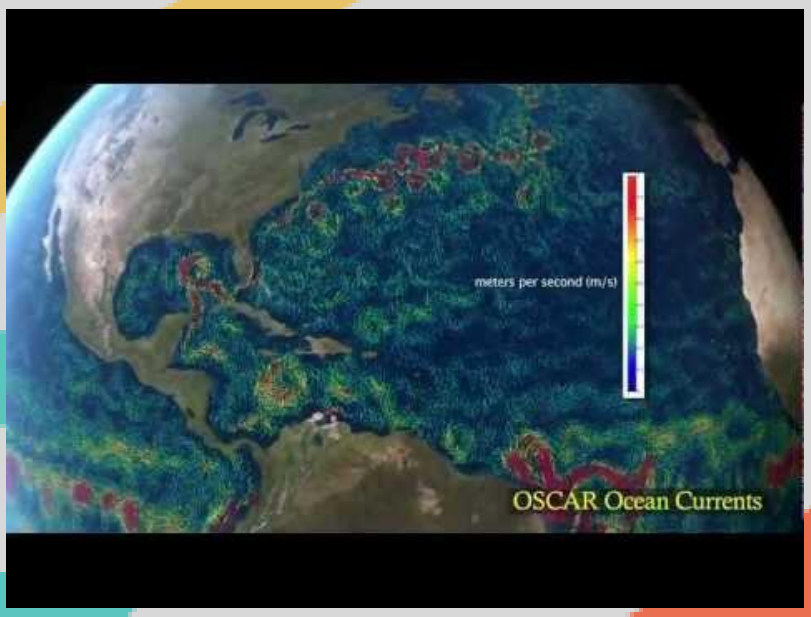
Half of the photosynthesis on Earth is carried out by marine phytoplankton, and the phytoplankton feed a massive number of animals in the ocean and many of these animals are consumed by humans. The ocean is a very important part of life on Earth and feeds a large part of our planet. Many people around world are dependent on the ocean for much of their food.

The ocean also regulates our climate and helps to regulate where the rain falls and how productive some areas of the land are as well. It's really true that ocean is life.



Video 6: Click image above to play

Information in this resource pack has been gathered from interviews with expert guests and then transcribed (not verbatim). All still Images are public domain or credited where appropriate. We do not claim ownership of any videos in this pack. Links to all videos are detailed below.

Bibliography

Video Links

1. Video 1: Some Animals Are More Equal than Others: Keystone Species and Trophic Cascades - YouTube
2. Video 2: Deadly Predators of the Reef | BBC Earth - YouTube
3. Video 3: Great Barrier Reef Management Zones - YouTube
4. Video 4: Great Barrier Reef | Exploring Oceans - YouTube
5. Video 5: ClimateBits: El Niño - YouTube
6. Video 6: NASA | The Ocean: A Driving Force for Weather and Climate - YouTube

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